

“...Still coughing”

Respiratory Block - Case 2

Professor Dr Samy Azer

MD, PhD (USyd), MEd (UNSW), FACP (USA), MPH (UNSW)

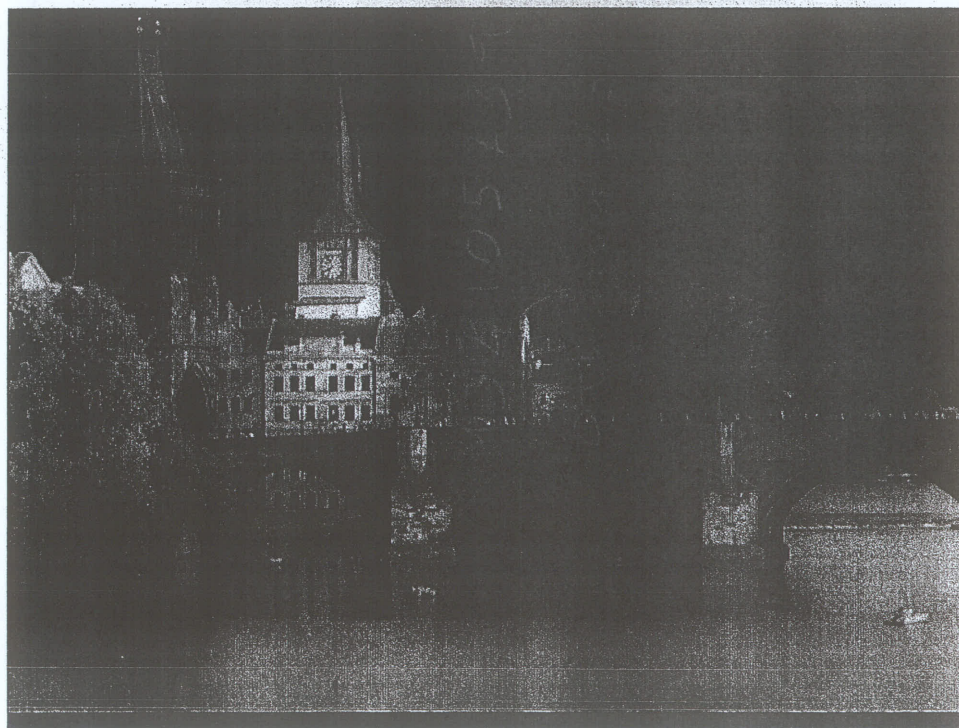
Professor of Medical Education

Chair of Curriculum Development Unit

Department of Medical Education

College of Medicine, King Saud University

Saudi Arabia



Learning Objectives:

This PBL Package targets the following objectives:

- Correlate the anatomy and ultra-structure (histology) of the lung with its function.
- Discuss the cough reflex and its significance.
- Discuss the pathology and microbiology of pulmonary tuberculosis.
- Construct a mechanism showing the pathogenesis of pulmonary tuberculosis in an adult.
- Discuss the pharmacology of drugs used in the treatment of tuberculosis.
- Construct a brief management plan showing the management goals, and management options for a patient with pulmonary tuberculosis and his/her contacts.
- Discuss mechanisms underlying the development of drug-resistant *Mycobacterium tuberculosis*.



Trigger

Khalid Allam, a 21-year-old third year medical student comes in to see Dr Sam Fekrey in his clinic because of a persistent cough with some phlegm on coughing for the last 3-4 weeks. He also has noticed shortness of breath particularly when he runs or climbs stairs.



Discussion Questions:

- Are there any difficult words you do not understand?
- List the key information about Khalid.
- Identify Khalid's presenting problems.
- For each problem makes a list of possible causes (hypotheses).
- What further information from history would you like to know at this stage to refine your hypotheses?



Trigger (Problems)

Khalid Allam, a 21-year-old third year medical student comes in to see Dr Sam Fekrey in his clinic because of a persistent cough with some phlegm on coughing for the last 3-4 weeks. He also has noticed shortness of breath particularly when he runs or climbs stairs.



New Terms/Difficult words

- *Phlegm.*
- *Cough*
- *Shortness of breath.*

Tutor: Encourage students to use a medical dictionary resource to discuss the meaning of each of these words.



Problems/Hypotheses

Persistent cough:

- Irritation of airways (e.g., smoke, chemicals, fluids).
- Respiratory infection (bacterial, viral, parasites)
- Allergies/bronchospasm (e.g., bronchial asthma).
- Postnasal drip (e.g., nasal secretions).
- Gastroesophageal reflux (e.g., acid/bile/gastric juice reflux).
- Drugs (e.g., angiotensin-converting enzyme inhibitors).
- Foreign bodies/small particles
- Tumours affecting the airways.
- Heart failure (e.g., Accumulation of fluids in the lung tissues).



Problems/Hypotheses

Phlegm (sputum) on coughing:

- Smoker cough.
- Infection of the upper respiratory tract (viral/bacterial).
- Bronchitis, pneumonia, bronchopneumonia.
- Heart failure (white frothy sputum with streaks of blood).
- Lung abscess.
- Bronchiectasis.
- Pulmonary tuberculosis.
- Postnasal discharge (e.g., sinusitis).

Imitation



Problems/Hypotheses

Shortness of breath on effort:

1. Lung disorders:

- idiopathic pulmonary fibrosis.
- severe curvature of the spine.
- obstructive disorders (e.g., bronchial asthma, obstructive pulmonary disease).
- lung cancer
- pneumothorax.
- pulmonary embolism.
- infection (e.g., pneumonia).
- pulmonary oedema.
- pulmonary congestion.
- pulmonary hypertension.
- occupational-lung disease.

Cardiac

2. Heart problems:

- Heart failure (cardiomyopathy, hypertensive-heart disease, ischemic heart disease etc)
- Valvular heart disease.
- Ischemic heart disease

3. Anaemia:

4. Psychological:

- anxiety.
- panic disorder.



Facilitation Questions

What is the mechanism underlying cough reflex?
 What is phlegm (sputum) formed of? How is phlegm formed?

Normally we do not have shortness of breath; what are the anatomical structures and functions do we need so that we breath normally?

What is the mechanism underlying increased respiratory rate during exercise (activity)?

Further Questions

- Cough → {
 - How long has the cough been present?
 - At what time of the day does the cough occur?
 - What factors bring your cough (e.g., cold air, body posture, talking, eating)?
 - Is the cough accompanied by chest pain, shortness of breath or wheezing chest?
 - Does the cough bring up sputum or blood?
- Sputum → {
 - What is the colour of your sputum? amount
 - Are there any symptoms of other disorders (e.g., gastroesophageal reflux, postnasal discharge)?
- Medication → {
 - Are you on any medication? Do you know the name of your medication?
- Cardiac → {
 - Any other symptoms such as chest pain, palpitation, or heart trouble?
- Fever → {
 - Any history of fever?

onset
 Duration
 what time of day
 what triggers
 Accompanying sy

Please Read The History

History

Khalid's cough started about 3-4 weeks ago. At that time Khalid was spending a week with his married sister in Jeddah and was seen by a local general practitioner. The doctor thought that Khalid has chest infection and prescribed a course of amoxicillin. Although Khalid completed the whole course of medication, his cough has worsened and becomes productive. His phlegm does not show any blood but Khalid has a lot of night sweats for the last three weeks. He also has noticed that he lost more than 8 kg in body weight over the last 4 months. He is worried about his health and decides to see his doctor in Riyadh Clinic, Dr Sam Fekrey.

Past medical history:

No past history of bronchial asthma, chest problems or hospital admission.

Khalid gives no history of similar cough or expectoration or coughing blood.

Two years ago Khalid had a positive Mantoux skin test when he was a first-year medical student. Chest X-ray at that time was reported to be normal.

Family history:

His mother died when he was 14 year old.

His father is 50 year old and is fine.

His two older siblings, one recently married and moved to live with her husband in Jeddah.

The other sister is in high school and is living with the father in a small village near Riyadh.

History (Continue)

Tobacco and alcohol

He does not smoke or drink

Medication and allergies

Nil

Social history

Khalid is from an average family. His father works as an assistant staff in the government but he is very keen for him and his sister to be educated. Khalid wants to become a doctor to fulfill his mother's dream. He is currently a third year medical student at King Saud University. He has moved to Riyadh from his home village. Although he misses his family back home, he phones them from time to time to talk to them.

Discussion Questions

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- Identify Khalid's new problems. Provide hypotheses for each problem.
- Use the new information obtained to refine your hypothesis.
- What further information would you like to know at this stage from the clinical examination?

New Terms/Difficult words

- *Amoxicillin*
- *Productive cough.*
- *Positive Mantoux Skin Test.*
- *Siblings.*

Tutor: Encourage students to use a medical dictionary resource to discuss the meaning of each of these words.



Problems/Hypotheses

Cough worsened despite treatment with amoxicillin:

- Not the proper drug for the condition.
- Not taking the medication regularly
- Not taking the recommended dose.
- The bacteria is resistant to amoxicillin.
- Duration of treatment was short.
- Other drugs or food interfering with amoxicillin and its effect.
- ? Residual cough.



Problems/Hypotheses

Night sweats: \approx Night fever

- Fever
- Infection (bacterial, viral).
- Cancer (increased catabolism).
- Hyperthyroidism (increased secretion of thyroxine).
- Too hot environment.
- Tuberculosis.



Problems/Hypotheses

Loss of bodyweight (8 kg in 4 months):

- Cancer (increased catabolism)
- Decreased caloric intake:
 - decreased appetite.
 - problem with digestion.
 - problem with absorption.
 - problem with metabolism.
- Uncontrolled diabetes mellitus.
- Chronic infections (e.g., pulmonary tuberculosis).
- Chronic diseases (e.g., heart failure, respiratory failure, renal failure, liver failure).
- Excessive exercise.
- Increased thyroxine secretion
- Anorexia.



Problems/Hypotheses

Worried about his health:

- Sudden changes in his health.
- His cough not responding to antibiotic treatment.
- Presence of several problems (cough, shortness of breath, loss of bodyweight).
- Unable to complete his studies because he is not well.
- Not sure about the nature of his illness.
- Afraid least he has cancer.
- Not sure about the future of his health.



Problems/Hypotheses

Positive Mantoux Skin Test and a normal chest X-ray:

A dose of 5 Tuberculin units (0.1 mL) is injected intradermally (between the layers of dermis) and read 48 to 72 hours later.

A person who has been exposed to the bacteria is expected to mount an immune response in the skin containing the bacterial proteins.

The reaction is read by measuring the diameter of induration (palpable raised hardened area) across the forearm (perpendicular to the long axis) in millimetres.

If there is no induration, the result should be recorded as "0 mm". If a person has had a history of a positive tuberculin skin test, or had a recent tuberculin skin test (within one year), another skin test should be used.



Problems/Hypotheses

Persistent cough:

- Irritation of airways (e.g., smoke, chemicals, fluids). ?/-
- Respiratory infection (bacterial, viral, parasites) ++/+++
- Allergies/bronchospasm (e.g., bronchial asthma). ?/+
- Postnasal drip (e.g., nasal secretions). ?
- Gastroesophageal reflux (e.g., acid/bile/gastric juice reflux). ?/-
- Drugs (e.g., angiotensin-converting enzyme inhibitors). /-
- Foreign bodies/small particles /-
- Tumours affecting the airways./?
- Heart failure (e.g., Accumulation of fluids in the lung tissues). ?/-



Problems/Hypotheses

Phlegm (sputum) on coughing:

- Smoker cough. /-
- Infection of the upper respiratory tract (viral/bacterial)./++
- Bronchitis, pneumonia, bronchopneumonia./++
- Heart failure (white frothy sputum with streaks of blood)./-
- Lung abscess./?
- Bronchiectasis./?
- Pulmonary tuberculosis./++
- Postnasal discharge (e.g., sinusitis).?/-



Problems/Hypotheses

Shortness of breath on effort:

1. Lung disorders:

- idiopathic pulmonary fibrosis. ?
- severe curvature of the spine. /-
- obstructive disorders (e.g., bronchial asthma, obstructive pulmonary disease)./-
- lung cancer ?
- pneumothorax. ?/-
- pulmonary embolism. ?/-
- infection (e.g., pneumonia). /+++
- pulmonary oedema. /-
- pulmonary congestion. /-
- pulmonary hypertension. /-
- occupational-lung disease. /-

2. Heart problems:

- Heart failure (cardiomyopathy, hypertensive-heart disease, ischemic heart disease etc)/-
- Valvular heart disease. /?
- Ischemic heart disease. /-

3. Anaemia: /-

4. Psychological:

- anxiety. /?/-
- panic disorder. /-



Problems/Hypotheses

Cough worsened despite treatment with amoxicillin:

- Not the proper drug for the condition.
- Not taking the medication regularly
- Not taking the recommended dose.
- The bacteria is resistant to amoxicillin.
- Duration of treatment was short.
- Other drugs or food interfering with amoxicillin and its effect.
- ? Residual cough.



Please Read The Clinical Examination

Clinical Examination

Khalid looks a little thin. His height is 172 cm, body weight 48 kg and his Body Mass Index (BMI) is 16.2 kg/m² (Normal= 22 – 25 kg/ m²) He is sweating all over and coughing a lot and produces phlegm. His sputum is thick and shows some streaks of blood. His vital signs are summarized in the table below:

Vital Signs:

Vital Signs	Khalid's findings	Normal Range
Blood pressure	110/70 mmHg	100/60 – 135/80 mmHg
Pulse rate	110/min regular	60-100/min
Temperature	38.5 °C	36.6 – 37.2 °C
Respiratory rate	22/min	12 – 16/min

Clinical Examination

Respiratory System

- His chest is flattened (small antero-posterior diameter).
- Percussion note is bilaterally normal except for the right upper zone- dull to percussion.
- On auscultation, nothing significantly found.

Cardiovascular System

- Normal

Abdominal Examination

- Normal

Clinical Examination

The doctor arranges for Khalid to do a chest X-ray.

Date: 11 January, 2011

Chest X-ray Report

Patient's name: Khalid Allam

Date of Birth: 27 January 1991

Address: Riyadh

Chest X-ray (Postero-anterior view)

An area of consolidation in the right upper lobe and increased lucency within the area of consolidation, consistent with early cavitation. The remainder of the lung zones and mediastinum are normal. The heart shadow is normal in shape and size.

Discussion Questions:

- Are there any terms that you do not understand?
- List the additional information about Khalid from clinical examination..
- On the basis of the new information from examination, do you think your hypotheses need to be refined or changed?
- Use the new evidence/information to rank your hypotheses.
- Summarise your learning issues.



New Terms:

- BMI.
- Percussion note.
- Streaks of blood.
- Dull to percussion.
- Consolidation.
- Postero-anterior view.
- Increased lucency.
- Cavitation.

Key Information:

- Looks thin, and decreased BMI.
- Increased sweating, coughing (with sputum).
- Streaks of blood are present in his sputum.
- Feverish 38.5 °C.
- Increased pulse rate, increased respiratory rate.
- Right upper zone dullness.
- Chest X-ray: upper right lobe increased lucency, consolidation, and early cavitation.
- Cardiovascular Examination: Normal.
- Abdominal Examination: Normal.

Problems/Hypotheses

Persistent cough:

- Irritation of airways (e.g., smoke, chemicals, fluids). /-
- Respiratory infection (bacterial, viral, parasites) ++/+++
- Allergies/bronchospasm (e.g., bronchial asthma). /-
- Postnasal drip (e.g., nasal secretions). /-
- Gastroesophageal reflux (e.g., acid/bile/gastric juice reflux). /-
- Drugs (e.g., angiotensin-converting enzyme inhibitors). /-
- Foreign bodies/small particles /-
- Tumours affecting the airways./?
- Heart failure (e.g., Accumulation of fluids in the lung tissues). /-



Problems/Hypotheses

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- Bronchitis, pneumonia, bronchopneumonia.? /++
- Heart failure (white frothy sputum with streaks of blood)./-
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- Bronchiectasis./-
- Pulmonary tuberculosis.?/+++
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Problems/Hypotheses

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- pulmonary oedema. /-
- pulmonary congestion. /-
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2. Heart problems:

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Problems/Hypotheses

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Problems/Hypotheses

Night sweats:

- Fever/+++
- Infection (bacterial, viral)./+++
- Cancer (increased catabolism).?
- Hyperthyroidism (increased secretion of thyroxine)./-
- Too hot environment. ?/-
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Problems/Hypotheses

Loss of bodyweight (8 kg in 4 months):

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- Decreased caloric intake: ?/+
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- Chronic diseases (e.g., heart failure, respiratory failure, renal failure, liver failure). /-
- Excessive exercise. /-
- Increased thyroxine secretion. /-
- Anorexia. /-



Problems/Hypotheses

Worried about his health:

- Sudden changes in his health. /+++
- His cough not responding to antibiotic treatment. /++
- Presence of several problems (cough, shortness of breath, loss of bodyweight). /+++
- Unable to complete his studies because he is not well. /?
- Not sure about the nature of his illness. ?/+++
- Afraid least he has cancer. ?
- Not sure about the future of his health. ?



Facilitation Questions

- What is the significance of his chest X-ray findings together with loss of body weight, fever, and persistent cough?
- How would you explain the presence of streaks of blood in his sputum?
- Are there any physiological differences between upper and lower zones of the lung?
- What is the significance of his upper lobe lesion?

Final Hypothesis

Most likely:

Chronic pulmonary disease affecting the right upper lobe causing consolidation, cavitation, fever, sweating, cough (expectoration of sputum with streaks of blood), shortness of breath, and loss of body weight.

These findings are consistent with pulmonary tuberculosis.

Less Likely/ or Excluded:

- Pneumonia.
- Bronchial asthma.
- Bronchitis.
- Heart failure.
- Chronic obstructive pulmonary disease.
- Lung abscess.
- Bronchiectasis.
- Upper respiratory tract infection.
- Lung cancer.
- Idiopathic pulmonary fibrosis.

Learning Issues

(Tutor: Encourage students to identify their learning issues that reflect key issues raised in the case. They might need to edit their learning issues into sentences or questions. Usually learning issues are about 5-7 key principles. See examples shown below).

Learning Issues

- ¹ Anatomy and ² histology of the lung. How does the anatomical structure of the lung correlate with its function?
- Why did his cough continue despite treatment with amoxicillin?
Possible hypotheses.
- ² Cough reflex and its significance.
- ³ Pathology and ⁴ microbiology of pulmonary tuberculosis.
- Pathogenesis of pulmonary tuberculosis in an adult.
- Pharmacology of drugs used in the treatment of tuberculosis.
- ⁵ Management goals and management plan for a patient with pulmonary tuberculosis and his/her contacts.

why upper lobe



Investigations

pharmacology



why TB is difficult to treat

Tutorial Two

Discussion Questions

After the students spent about 60 minutes addressing their learning issues. You might spent 10-15 minutes on these questions:

Discussion Questions:

- What is your final hypothesis? Explain why?
- What other investigations you may order to confirm your refined hypothesis? Explain your reasoning for each test you order.



Please Read Investigations

Investigations

Dr Sam Fikrey arranges for some blood tests. He also sends sputum samples to the Microbiology Laboratory, with a history note on the order form stating, "history of positive Mantoux skin test results and consolidation in the right upper lung lobe with possible early cavitation".

The results of the investigations are shown below:

Full Blood Examination:

Blood test	Khalid's results	Normal Range
Haemoglobin (Hb)	115	115-160 g/L
Packed cell volume (PCV)	39	37-47 %
White cell count (WCC)	5.8	4.0 – 11.0 x 10 ⁹ /L
Platelet count	270	150-400 x 10 ⁹ /L
Erythrocytes Sedimentation Rate (ESR)	55	Less than 15 mm/hr

Investigations

Microbiology Studies:

Date: 11 January, 2011

Microbiology Report

Patient's name: Khalid Allam

Date of Birth: 27 January 1991

Address: Riyadh

Specimen type: Sputum

Report: The Ziehl-Neelsen (ZN) stain of sputum reveals the presence of chronic inflammatory cells, mainly lymphocytes and a large number of acid-fast bacilli (AFB).

Sputum culture: Pending

Discussion Questions

- Are there any terms that you do not understand?
- List the additional information about Khalid's presentation.
- On the basis of the new information from investigation results, do you think your hypotheses need to be refined or changed?
- What would you like to do at this stage?
- What are your management goals and management options?

Please Read Progress 1

Progress 1

Dr Sam Fekrey discusses the results with Khalid and refers him to a nearby hospital. He also contacts the respiratory consultant and discusses with him Khalid's case. On the basis of the Ziehl-Neelsen stain of the sputum (the presence of the acid-fast bacilli and chronic inflammatory cells), Khalid is admitted to an isolation room and commenced on treatment for tuberculosis. The case has been notified to the Department of Health with a provisional diagnosis of "Pulmonary TB".

In the hospital, the consultant explains to Khalid the nature of his respiratory infection and that he requires prolonged drug therapy of at least 6 to 9 months.

Khalid is commenced on isoniazid, rifampicin, ethambutol, pyrazinamide and pyridoxine (vitamin B₆). Khalid continues to take medications regularly together with pyridoxine tablets for two months. Then Dr Sam Dr Fekrey asks him to continue on isoniazid and rifampicin only for another seven months. During this time, Khalid is seen by his treating physician once every month for check-up and follow-up investigations.

Discussion Questions

- Are there any terms you do not understand?
- Why does Khalid need to be treated with 4 drugs and for a prolonged period?
- What type of follow-up investigations do you think are recommended for Khalid case?
- Apart from medications, what are your management plans and management options?

TB bacilli are

- slowly growing
- Coated with a waxy outer layer
- develop resistant mutants

(doesn't matter if immunity develops to one of the drugs)

Facilitation Questions

- Why did the doctor prescribed vitamin B6 (pyridoxine) together with anti-tuberculous drugs?
- What is the mechanism by which anti-tuberculous drugs work?
- Discuss the pathogenesis of pulmonary tuberculosis?

to prevent development of peripheral neuropathy

Please Read the Closure

Case Closure

The health authorities decide to screen Khalid's friends and his family and any other people he was in contact before his treatment for pulmonary tuberculosis. This is usually done by Mantoux skin testing.

Over the next four months of treatment, Khalid feels much better and has no more cough, expectoration, fever or night sweats. His appetite has improved and his body weight has increased by three kilograms over the last four months. Repeated chest X-rays has demonstrated improvement and resolution of the area of consolidation. Follow-up sputum examinations showed no acid-fast bacilli.